International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 5 Issue 4, May-June 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Adulteration of Natural Fibers

B. Dhananjaneya[1], H. Sravan Kumar Reddy[1], M. Praveen Kumar[1], V. Raghunath[1], U. Upendra Reddy[1], Dr. C. V. Raja Reddy M Tech, Phd[2]

[1]Student, [2]Professor and Head of the Department,
[1,2]Department of Mechanical Engineering Sanskrithi School Of Engineering Puttaparthi, Andhra Pradesh, India

ABSTRACT
This experimental study mainly focuses on increasing Mechanical properties of the composite by Adulteration of natural fibres Coir and Hemp. Different combinations of the fibres within the optimum level are tested, evaluated and compared such that to obtain best combination that enhances the mechanical properties like flexural, tensile and impact properties. For Fabrication of composite, Hand layup method is used. The tests on the specimen are carried according to the ASTM Standards. SEM (Scanning Electron Microscope) is used to carry out the INTERFACIAL ANALYSIS such that to study micro structural behaviour and to find out the causes of failure

NOMENCLATURE
The detailed view about the ADULTERATION OF NATURAL FIBERS and it's working principles.

KEYWORDS: *Hemp, Polyester Resin, Accelerator, Catalyst, Mould Releasing Agent, Glass Mould, Hand Roller*

How to cite this paper: B. Dhananjaneya | H. Sravan Kumar Reddy | M. Praveen Kumar | V. Raghunath | U. Upendra Reddy | Dr. C. V. Raja Reddy "Adulteration of Natural Fibers" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-4, June 2021, pp.1259-1265, URL: www.ijtsrd.com/papers/ijtsrd42542.pdf

IJTSRD42542

INTRODUCTION

Natural adulteration occurs due to the presence of certain chemicals, organic compounds or radicals naturally occurring in foods which are injurious to health and are not added to the foods intentionally or unintentionally. Here we going to create new composite material using natural fibers and with polyester resin. Different combinations of the fibres within the optimum level are tested, evaluated and compared such that to obtain best combination that enhances the mechanical properties like flexural, tensile and impact properties

MATERIALS USED

- Coir
- Hemp
- Polyester Resin
- Accelerator
- Catalyst
- Mould Releasing Agent
- Glass Mould
- Hand Roller

COIR

Coir (also known as "Kokos" or "Coco") is a natural seed-hair fiber obtained from the outer shell or husk, of the coconut, the fruit, extensively grown in tropical countries. Coir yarn has been produced in the coastal belt of Kerala.Coir or coconut fiber belongs to the group of hard structural fibers, and is lignocellulosic in nature. Coir fiber has the advantage of stretching beyond its elastic limit without rupturing.

COIR

Properties of coir fiber (Bledzki et al., 1996; Chand and Rohtgi, 1994)

HEMP

Industrial hemp (Cannabis sativa) is an inexpensive and available bast natural fiber. It is one of the fastest growing plants. Hemp has been used over many centuries, for end users ranging from textiles and papers (hemp paper was used in the first copies of the Bible) to ropes and sails. The hemp plant is native to India and Persia, although it has been cultivated in nearly all temperate and tropical countries. Russia is the largest hemp fiber producer, accounting for about 33% of the annual world production. Hemp is a tall and annual crop plant, which is normally ready to harvest in two to three months after seeding.

Physical Properties of Hemp

Density(g/cc)	1.4
Tensile Strength(MPa)	550-900
Elastic Modulus(GPa)	70
Specific Strength(s/g)	393-643
Specific Modulus("/g)	50
Elongation of Failure (%)	1.6
Moisture Absorption (%)	6-12

POLYESTER RESIN

Polyester resins are the most economical resin systems used in engineering applications, but with limited use in high performance composites. They can be produced for a large variety of properties, from soft and ductile to hard and brittle. The principal advantages of polyesters are: low cost, low viscosity, and a relatively short curing period. Polyester resins can be formulated to cure at either room or elevated temperatures.

Mechanical Properties of Polyester (Unsaturated polyester Resin properties)

Viscosity at 25°C μ (cP)	250-350
Density ρ(g/cm³)	1.9
Heat Distortion Temperature HDT(°c)	85
Modulus of Elasticity E (GPa)	3.3
Flexural Strength(MPa)	45
Tensile Strength(MPa)	40
Maximum Elongation (%)	1

ACCELERATOR

Cobalt octoate is generally used as accelerator for polyester resins. Curing Unsaturated Polyester resins at room temperature cannot be effected by an organic peroxide only, an accelerator should be added as well. In most cases cobalt octoates are preferred, as they can be applied in combination with a wide range of peroxides and besides, because of some specific properties, viz:

- By varying the quantity of cobalt octoate, the reaction speed can be rather well adapted to the working circumstances.
- The pot life of the polyester resin is hardly influenced by the addition of cobalt accelerator.
- Cobalt accelerators have a rather small influence on the resin color. The resin is not discolored by U.Vlight.
- Cobalt accelerators make a resin less sensitive to air inhibition.
- It should be taken into consideration, however, that pigments and fillers easily absorb cobalt accelerators and render them inactive.

- A dosage of minimum 0.3% is necessary to get on efficient cure reaction at room temperature. Also at elevated temperatures small amounts of cobalt accelerator are used to speed up the reaction (corrugated sheeting, filament winding).

Cobalt Octoate

CATALYST

M.E.K.P (methyl ethyl ketone peroxide) is colorless organic peroxide used to catalyze Polyester Resins and Gelcoats.

When M.E.K.P. is mixed with polyester based resins or Gelcoats, the resulting chemical reaction causes heat to build up and cure or harden the resin.

Our polyester resins are used with an M.E.K.P. catalyst at a 2% ratio based on volume. However, extra M.E.K.P catalyst maybe required in cooler temperatures or if faster drying times is desirable.

MEKP is a highly toxic clear liquid. It is a strong oxidizing agent and a corrosive. Acute and chronic toxicity can occur as an occupational hazard. MEKP catalyst should be used carefully used and stored.

MOULD RELEASING AGENT (WAX)

Composite parts are generally made in a female mold. The wax would be applied to a prepared mold surface and then backed with layers of reinforcement and additional resin. When the part is removed from the mold, this wax surface

would be the exterior surface of the part and it is acted as mould releasing agent. In our case in the preparation of specimen the top surface is also closed with OHP sheet which is coated with wax in order to attain smooth surface.

GLASSMOULD

Moulds can be made from a wide variety of materials and in a number of ways but moulds for composites need to be compatible with the resin system and curing. We used glass mould for making the composite specimen and its measurements are

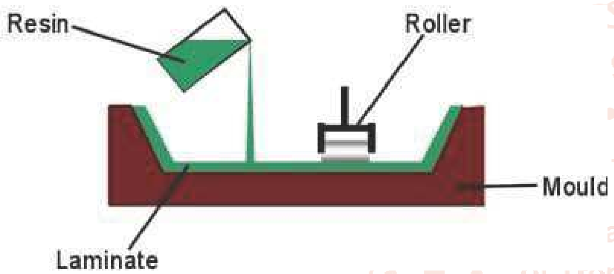
Length=200mm, Width=200mm, Depth = 3mm

GLASSMOULD

HANDROLLER

Hand roller is used with Natural or synthetic fiber, and other woven reinforcements, they help significantly in eliminating small air bubbles and pin- holes, which very often cause a 'glitter' effect .

They are also useful to roll the wet composite to ensure an enhanced interaction between the reinforcement and the matrix, to facilitate a uniform resin distribution, and to obtain the required thickness of the composite.

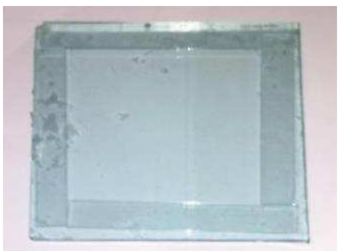


Hand Rolling Process

COMPOSITION OFCOMPOSITE

FIBER VOLUMEFRACTION

Fiber volume ratio is an important mathematical element in composite engineering. Fiber volume ratio, or fiber volume fraction, is the percentage of fiber volume in the entire volume of a fiber-reinforced composite material. When manufacturing polymer composites, fibers are impregnated with resin. The amount of resin to fiber ratio is calculated by the geometric organization of the fibers, which affects the amount of resin that can enter the composite. The impregnation around the fibers is highly dependent on the orientation of the fibers and the architecture of the fibers. The geometric analysis of the composite can be seen in the cross-section of the composite. Voids are often formed in a composite structure throughout the manufacturing process and must be calculated into the total fiber volume fraction of the composite. The fraction of fiber reinforcement is very important in determining the overall mechanical properties of a composite. A higher fiber volume fraction typically results in better mechanical properties of the composite.



The amount of fiber in a fiber reinforced composite directly corresponds with the mechanical properties of the composite.

1. Adding too little fiber reinforcement in the composite will actually deteriorate the properties of the material.
2. Too much fiber volume may also decrease the strength of the composite due to the lack of space for the matrix to fully surround and bond with the fibers.

FIBER WEIGHT FRACTION

Fiber weight fraction or fiber weight ratio is similar to fiber volume fraction, but instead of total volume of composite, total weight of composite is considered and here ratio is between the weight of fiber to the weight of the matrix or resin.

COMBINATIONOFFIBERSANDMATRI XOR RESIN

On studying the research papers (Reference 1) about coir composite we came to know that coir mechanical properties are best at 20 % weight percentage and fiber length of 150 m

Hemp is well-known for its better properties in Following table shows the designation of five samples Designation of Samples

S. No	SAMPLE	DESIGNATION
1	S1	C0H20
2	S2	C5H15
3	S3	C10H10
4	S4	C15H5
5	S5	C20H0

Designation of Samples

CONSTRUCTION METHOD

Hand layup process

Hand lay-up, which is the most common and widely used open mould composite manufacturing process. Initially, a thin layer of anti adhesive coat (wax) is applied on the glass mould for easy extraction. Then small amount of the polyester resin is poured or applied using a brush in the mould and the prepared fibers are placed in the glass mould. The remaining resin is applied on the fibers and a roller is used to force the resin into the composites .Here making 20% wt ratio is maximum condition and different proportions of coir and hemp are mixed and on conducting mechanical tests, best combination of coir and hemp at different mechanical tests is to be identified.

Five samples are prepared on consideration of different Composition based on weight percentage.

Following table gives the information about composition of fibers and resin. (Note: considering no voids in the composite

Designation of samples

All the five samples are given with specific names for ease of identification of percentage of fibers. For example sample (S2) is denoted as C5H15 such that represent weight percentage of hemp Following table shows the designation of five samples fabrics to ensure an

HYBRID COMPOSITES

Hybrid composite is generally used to describe a matrix containing at least two types of reinforcements, but this report is restricted to hybrid composites containing two types of reinforcing fibers. Such composites are also called 'fiber hybrids' or 'fiber hybrid composites'. This report focuses on polymer matrix composites, though some hybrid composites having ceramic or metal matrices.

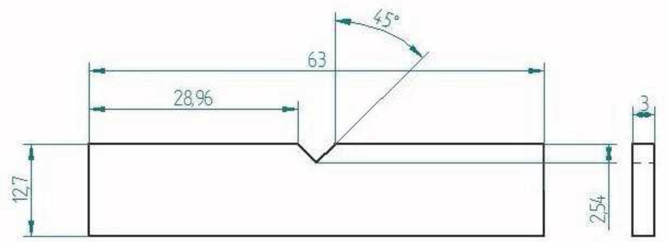
IMPORTANCE OF FIBERHYBRIDIZATION

Lightweight design is becoming increasingly important in various industries, particularly in aerospace, wind energy

and automotive applications. Fiber- reinforced composites are attracting more interest for these weight-sensitive applications as their excellent stiffness and strength are combined with a low density. Unfortunately, the high stiffness and strength of these composites come at the expense of their limited toughness. Like most materials, fiber-reinforced composites also face the strength versus toughness dilemma. Because of the drawbacks of these toughening strategies and the strong need for new lightweight materials with improved toughness, the research interested in "hybridization",

Fiber hybridization is a promising strategy to toughen composite materials. By combining two or more fiber types, these hybrid composites offer a better balance in mechanical properties than non-hybrid composites. Predicting their mechanical properties is challenging due to the synergistic effects between both fibers.

TESTING STANDARDS AND TESTINGEQUIPMENT
ASTMSTANDARDS



ASTM International, formerly known as American Society for Testing and Materials, is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials(i.e composite materials also), products, systems, and services.

ASTM International is providing no-cost public access to important ASTM standards, which are used in the production and testing of materials...etc

Here we discuss some of the testing standards (ASTM) of composite materials whereas the testing like tensile testing, impact testing, flexural testing.

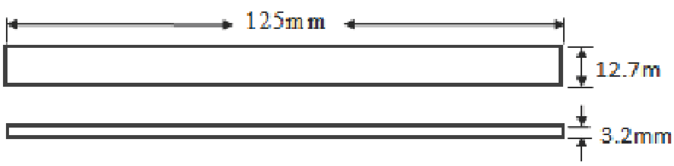
ASTMD638
ASTM D638 is the most common testing standards for determining the tensile properties of the reinforced composite.

The dimensions for ASTM D638 is 3.2×19×165 .The specimen is of dog bone shape and other dimensions are shown in the following diagram and Specimen is prepared as per the standards

Specimen Dimensions of ASTM D638

ASTMD790
ASTM D790 is one of the testing standard used for determining the flexural properties for reinforced composite and its dimensions are 3.2mm x 12.7mm x 125mm (0.125" x 0.5" x 5.0") .The following figure gives the shape and sizes of the specimen.

Specimen Dimensions of ASTM D790



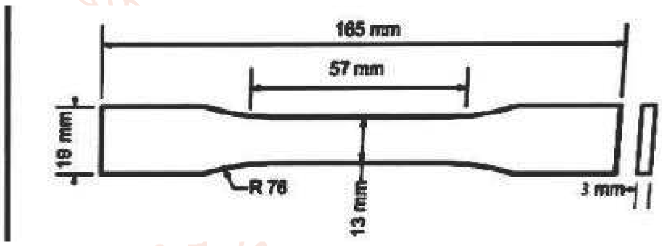
ASTM D256
ASTM D256 is the testing standard used for determining the toughness of the reinforced composite. The standard size of specimen for ASTM D256 is 64 x

12.7 x 3.2 mm. The most common specimen thickness is 3.2 mm, but the preferred thickness is 6.4 mm because it is not as likely to bend or crush. The depth under the notch of the specimen is 10.2 mm.

Dimensions of ASTMD256

TESTING EQUIPMENT
Continued advancements in the design and manufacture of engineered composites have allowed composite materials to work their way into the products we use every day. The most common modern advanced composites are fiber-matrix composites and they can be manufactured with polymer, carbon, metal, or ceramic matrix and an extremely wide range of reinforcement fiber including, carbon, boron, aramid, natural fibers and glass.

ASTM and ISO have developed standard test methods for testing composite materials. Standards provide methods that can be recreated, ensuring materials are tested in the same manner and within the conditions and allowing test results validation between manufacturers and customers.



Our composite material gone through four different tests tensile testing, flexural strength testing, impact testing and SEM Analysis. Following information gives the information of the equipment

Tensile Testing
Tensile testing is used to measure the tensile strength of the specimen. Most common testing machine used in tensile testing is the universal testing machine. This type of machine has two crossheads; one is adjusted for the length of the specimen and the other is driven to apply tension to the test specimen. There are two types: hydraulic powered and electromagnetically powered machines.

Alignment of the test specimen in the testing machine is critical, because if the specimen is misaligned, either at an angle or offset to one side, the machine will exert a bending force on the specimen. This is especially bad for brittle materials, because it will dramatically skew the results. This

situation can be minimized by using spherical seats or U-joints between the grips and the test machine.

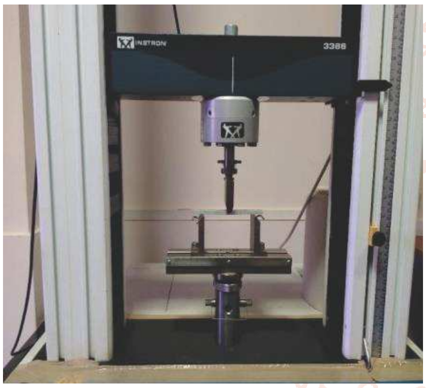
The strain measurements are most commonly measured with an extensometer. The data is often used to select the materials which are strong enough to withhold tensile loads. The following figure shows the tensile testing machine.

Tensile Testing Machine

Flexural Testing

The flexural test measures the force required to bend a beam under three point loading conditions or four point load condition. Here we use three point load condition. The data is often used to select materials for parts that will support loads without flexing.

Most commonly the specimen lies on a support span and the load is applied to the center by the loading nose producing three point bending at a specified rate. The parameters for this test are the support span, the speed of the loading, and the maximum deflection for the test. These parameters are based on the test specimen thickness and are defined differently by ASTM and ISO. For ASTM D790, the test is stopped when the specimen reaches 5% deflection or the specimen breaks before 5%.



Izod Impact Testing

Izod Impact is a single point test that measures a materials resistance to impact from a swinging pendulum. Izod impact is defined as the kinetic energy needed to initiate fracture and continue the fracture until the specimen is broken. Izod specimens are notched to prevent deformation of the specimen upon impact. This test can be used as a quick and easy quality control check to determine if a material meets specific impact properties or to compare materials for general toughness.

The specimen is clamped into the pendulum impact test fixture with the notched side facing the striking edge of the pendulum. The pendulum is released and allowed to strike through the specimen. If breakage does not occur, a heavier hammer is used until failure occurs.

Izod Impact Testing Mach

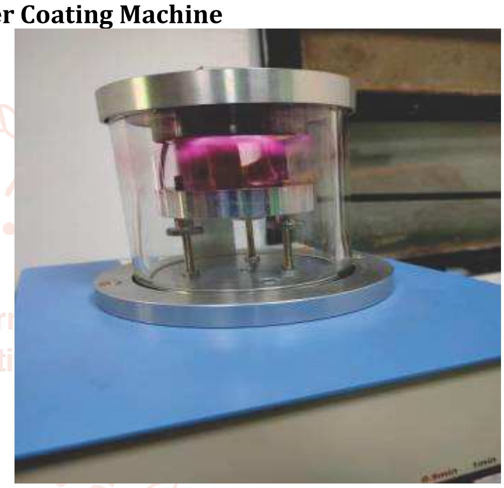
SEM Analysis

A scanning electron microscope (SEM) is a type of electron microscope that produces images of a sample by scanning it with a focused beam of electrons and used to reveal micro structural information of fractured surfaces of composites. To obtain a high quality image the sample should be conductive. But there are some non conductive samples and beam sensitive samples.

Those types of samples are more challenging and require an extra step as the sample is prepared to gather high-quality information. This extra step involves coating your sample with an additional thin layer of about 10 nanometers (nm) of a conductive material such as gold, silver, platinum, or chromium. This carried procedure for preparation of sample is called SPUTTER COATING.

Then the prepared sample is further studied in SEM to obtain the micro structural information of fractured surface and also the bonding between the Matrix and Reinforcement.

Sputter Coating Machine



Sputter Coating on Composite (Gold isCoated)

Scanning Electron Machine (SEM)

COMPOSITEPREPARATION ANDTESTING

The following are the series of steps involved from the mould making to the final step of testing of the composite.

The series of steps are
1. Mould Preparation
2. Preparation of polyester resin(matrix)
3. Anti adhesive coating
4. Fiber preparation
5. Hand layup
6. Curing
7. Preparation of specimens
8. Testing

1. Mould Preparation

Moulds can be made from a wide variety of materials and in a number of ways but moulds for composites need to be compatible with the resin system and curing. We used glass mould for making the composite specimen and also using glass gives good finish to the composite specimens.

The mould used for preparing composites is made from rectangular glass having dimensions of 200 mm× 200 mm. Four glass beadings were used to maintain a 3 mm thickness all around the mould .The another glass plate is used to cover and compress the fiber after the resin is applied, and also to avoid the debris from entering into the composite parts during the curingtime

Mould and Covering Glass

1. Preparation of Polyester Resin
Unsaturated polyester resin has been chosen for matrix for its good cross- linking tendency and process ability. For 100 ml of resin, 0.75 ml of MEKP (Methyl Ethyl Ketone Peroxide) and 0.65ml of Cobalt octoate were taken at ambient temperature as per the manufacturer's recommendations.

100ml Polyester resin is taken in to a beaker and by using transfer pipette dropper the appropriate amount of catalyst and accelerator is mixed with the resin .For stirring a wooden stick is used.

2. Wax Coating
A thin layer of anti-adhesive coat or mould releasing agent is applied to the mould surface for easy extraction of the composite from the mould.

We used solid wax as an anti adhesive coating and is applied on the glass mould evenly .wax melts on slight heating so that it makes easy to remove the composite from the mould.

Wax Coated Mould

3. Fiber Preparation
Coir and hemp fibers are combed such that to remove the shorter fibers and the remaining longer fibers are trimmed such that they can fit into the mould perfectly.

As mentioned in the chapter 4 about the combination of fibers and resin, the fibers are weighed according to the proportions and fibers are mixed according to the intrayarn (fiber to fiber) hybrid configuration.

4. Hand Layup
Hand lay-up, which is the most common and widely used open mould composite manufacturing process. Initially, a thin layer of anti adhesive coat (wax) is applied on the glass mould for easy extraction. Then small amount of the polyester resin is poured or applied using a brush in the mould and the prepared fibers are placed in the glass mould. The remaining resin is applied on the fibers and a roller is used to force the resin in to the fabrics to ensure an enhanced interaction between the reinforcement fibers and polyester resin (matrix) and same procedure is used for the all the samples.

5. Curing
After the completion of hand layup procedure the moulds are allowed to cure about 24 hours. The process of curing of occurs in three main phases: pre-gel, gel point and post-gel. During the pre-gel phase, the material may flow and undergo molecular rearrangement here we used roller to force the resin in the fibers .Gel point where the resin is thick and viscous in nature and final phase post gel here the resin gets harder. For better hardness we allow it to cure about 24 hours.

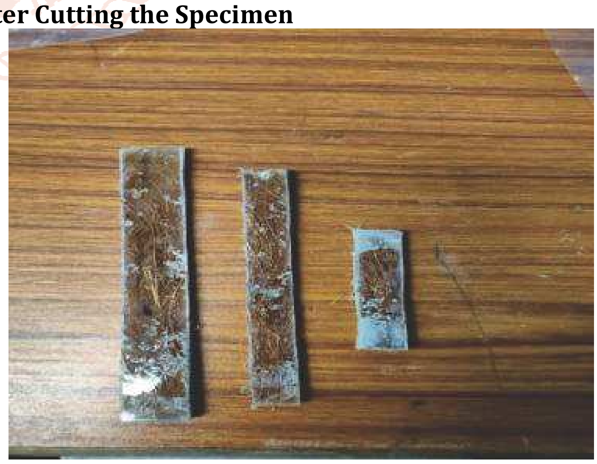
After curing the moulds are heated up in Owen so that the wax gets melted and allows for easy extraction of composite from the glass mould.

Mould After Curing

6. Preparation of Specimens
Removed composites are cleaned and cutting operations are performed on the composite to get them for the required dimensions and shapes as according to the ASTM STANDARDS which are mentioned in the

7. TESTING STANDARDS AND TESTING EQUIPMENT.
Cutting of Specimen

After Cutting the Specimen



8. CONCLUSION
In tensile tests different combinations of hemp and coir given poor results but as expected the sample with totally hemp fibers had given great results and As the coir percentage is increasing the tensile strength is decreasing this shows coir fiber is poor in tensile strength.

Hybridization of coir and hemp fibers with weight percentage of 15 and 5 (sample C15H5) respectfully has given better results in flexural and impact test when compared to the other samples

In sem analysis we observed fiber pullouts and voids caused due to fiber pull outs this is all due to hydrophilic character of natural fibers which results in poor interfacial interaction between the resin matrix and fibers

Also observed the trapped air bubbles and internal voids which are caused due to improper rolling and improper curing. The cracks and the striations are caused due to sudden forces applied on the composite and load variation also causes these striations

Further research work needs to be carried out in the developed of natural fiber composites. This is important if new improved materials are to be developed for safe usage against crack growth and environmental pollution. Hybrid fiber composites with coir and hemp fibers may open up new applications. However as inferred from the results presented here, significant improvements in flexural strength and toughness characteristics are noticed for this class of materials.

REFERENCES

[1] Influence of fiber parameters on tensile, flexural, and impact properties on nonwoven coir-polyester composites. S. jayabal & U. Natarajan, The international Journal of advanced technology volume 54, pages 639- 648(2011).

[2] Torres FG, Cubillas ML. Study of the interfacial properties of natural fiber reinforced polyethylene. Polym Test 2005; 24:694–8.

[3] Shinichi SA, Yong C, Isao F. Press forming of short natural-fiber reinforced biodegradable resin: effects of fiber volume and length on flexural properties. Polym Test 2005; 24:1005– 11.

[4] Maries I, Abderrahim B, Umadevi L, Laurent IL, Sabu T. Thermophysical properties of natural fiber reinforced polyester composites. Compos Sci Technol2006; 66:2719–25.

[5] Guohua W, Bharat B, Peter MT. Nanochemical characterization Of human hair using nano indentation and SEM. Ultra microscopy 2005; 105:248–66.

[6] Geethamma VG, Kalaprasad G, Gabriel G, Sabu T. Dynamic mechanical behavior of short coir fiber reinforced natural rubber composites. Composites 2005; 36:1499– 506.

[7] Sapuan SM, Leenie A. Mechanical properties of woven banana fiber reinforced epoxy composites. Mater Des 2006; 27:689–93.

[8] Harriette LB, Jorg M, Van den Oever MJA. Mechanical properties of Short-flax-fiber reinforced compounds. Composites part A. Appl Sci Manuf 2006; 37:1591–604.

[9] Shalwan A, Yousif BF., "In state of art: mechanical and tribological behaviour of polymeric composites based on natural fibres." Mater Des 2013; 48(0):14–24.

[10] Rahul Shrivastava et al. "Effect of Chemical Treatment and Curing Parameters on Mechanical Properties of Natural Fiber Reinforced Polymer Matrix Composites- A Review", Journal of Engineering Research and Applications. Vol. 5, Issue 6, (Part -1) June 2015, pp.70-75.

[11] Rao H.R. Khamar M.K., Reddy G.R., "Hybrid composites: Effect of fibers on mechanical properties", International Journal of Macromolecular Science 2011; 1, pp.9-14.

[12] Sanjeevamurthy C. G., Srinivas G. R. "Sisal/Coconut Coir Natur al Fibers - Epoxy Composites: Water Absorption and Mechanical Properties", International Journal of Engineering and Innovative Technology, 2012; 2(3), pp.166-170.